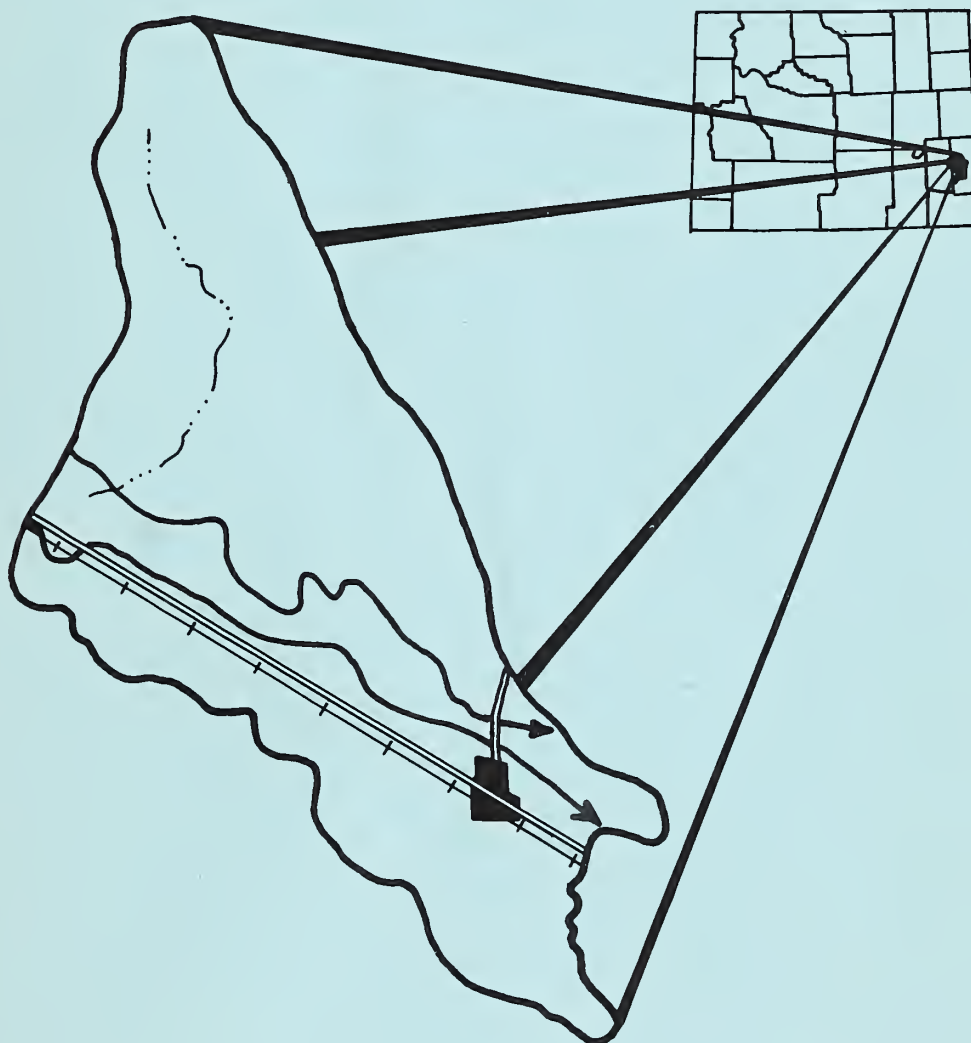


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WATERSHED WORK PLAN
SPRING CANYON WATERSHED
GOSHEN COUNTY, WYOMING



LINGLE-FT. LARAMIE CONSERVATION DISTRICT

October 1974

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WATERSHED WORK PLAN

Spring Canyon Watershed

Goshen County

Wyoming

CONTENTS

Introduction

Part 1 - Discount rate comparison

Part 2 - Display of impacts to national economic development,
environmental quality, regional development, and social
well-being accounts

Part 3 - Display of the abbreviated environmental quality alternative

INTRODUCTION

This addendum is based on procedures established for application of the Water Resources Council's Principles and Standards to implementation studies in process.

The Spring Canyon watershed work plan was developed using 1973 installation costs, a 5 5/8 percent discount rate, and adjusted normalized prices in the evaluation of the project structural measures.

Part 1 of this addendum shows the effect of evaluating the structural measures using current installation costs, current normalized prices for agricultural products, and the current discount rate.

Part 2 of the addendum displays the effects of the selected plan as evaluated for each of the separate accounts--national economic development, environmental quality, regional development, and social well-being. Values for costs, prices, and rates are those of the work plan.

Part 3 of the addendum displays an abbreviated alternative plan developed to emphasize environmental quality. Bases for costs, prices and rates are those of the work plan.

DISCOUNT RATE COMPARISON

This shows the effect of evaluating the structural measures using 5 7/8 percent discount rate, 1973 installation costs, and current normalized prices for agricultural products.

Average annual costs, benefits, and the benefit-cost ratio are as follows:

1. Average annual costs are \$37,225
2. Average annual benefits are \$63,385
3. The benefit-cost ratio is 1.7:1.0
4. The benefit-cost ratio without
secondary benefits is 1.5:1.0

SELECTED ALTERNATIVE
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Spring Canyon Watershed, Wyoming

NED - BENEFICIAL EFFECTS ^{1/}

A. The value to users of increased outputs of goods and services

1. Flood Prevention	\$33,720
Total Beneficial Effects	\$33,720

NED - ADVERSE EFFECTS ^{1/}

A. The value of resources required

1. Flood Prevention Reservoir	
- Construction	\$27,350
- Project Administration	4,250
- OM&R	500
Total Adverse Effects	\$32,100

NET BENEFICIAL EFFECTS \$ 1,620

1/ Average Annual

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SELECTED ALTERNATIVE
ENVIRONMENTAL QUALITY ACCOUNT

Spring Canyon Watershed, Wyoming

EQ - Beneficial and Adverse Effects

A. Areas of Natural Beauty

1. Improve vegetative cover in the watershed.
2. Disrupt vegetative cover on about 75 acres of rangeland for about 2 years.
3. Decrease erosion.
4. Reduce flooding and associated sediment and debris deposition.

B. Biological Resources and Selected Ecosystems

1. Replace weedy wildlife habitat on 85 acres cropland with habitat found on intensively farmed irrigated cropland.
2. Improve vegetative cover in the watershed.

C. Irreversible or Irretrievable Commitments

1. Commit about 100 acres of rangeland to use as dam and reservoir.

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SELECTED ALTERNATIVE
REGIONAL DEVELOPMENT ACCOUNT

Spring Canyon Watershed, Wyoming

<u>RD - Beneficial Effects:</u> Income <u>1/</u>	<u>Wyoming</u>	<u>Rest of Nation</u>
A. The value of increased output of goods and services to users residing in the region		
1. Flood Prevention	\$33,720	-
B. The value of output to users residing in the region from external economies		
1. Induced by and stemming from effects	\$ 4,150	-
 TOTAL Beneficial Effects	 \$37,870	 -

1/ Average Annual

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SELECTED ALTERNATIVE
REGIONAL DEVELOPMENT ACCOUNT (Continued)

Spring Canyon Watershed, Wyoming

<u>RD - Adverse Effects:</u> Income	<u>Wyoming</u>	<u>Rest of Nation</u>
A. The value of resources contributed from within the region to achieve the outputs		
1. Flood Prevention Reservoir		
- Installation	\$ 555	\$26,795
- Project Administration	285	3,965
- OM&R	500	0
 TOTAL Adverse Effects	 \$ 1,340	 \$30,760
 NET BENEFICIAL EFFECTS	 \$36,530	 -\$30,760

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SELECTED ALTERNATIVE
REGIONAL DEVELOPMENT ACCOUNT (Continued)

Spring Canyon Watershed, Wyoming

<u>RD - Beneficial Effects:</u> Employment	<u>Wyoming</u>	<u>Rest of Nation</u>
A. Increase in number and type of jobs		
1. Employment for project construction	17 semi-skilled jobs for 1 year	-
2. Employment for project OM&R	1 man-month semi-skilled permanent	-
TOTAL Beneficial Effects	1 man-month semi-skilled permanent	-
	17 semi-skilled jobs for 1 year	-
 <u>RD - Adverse Effects:</u> Employment	 <u>Wyoming</u>	 <u>Rest of Nation</u>
A. Decrease in number and types of jobs	0	-
TOTAL Adverse Effects	0	-
NET BENEFICIAL EFFECTS	1 man-month semi-skilled permanent	-
	17 semi-skilled jobs for 1 year	-

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SELECTED ALTERNATIVE
SOCIAL WELL-BEING ACCOUNT

Spring Canyon Watershed, Wyoming

Social Well-Being - Beneficial and Adverse Effects

A. Real Income Distribution

1. Create 1 man-month of semi-skilled permanent employment and 17 semi-skilled jobs for 1 year.
2. Create regional income benefit distribution of \$37,870 by income class as follows:

<u>Income Class</u> --Dollars--	<u>Percentage with</u> <u>Adjusted Gross Income</u>	<u>Percentage of</u> <u>Benefits</u>
Less than 3,000	16	17
3,000 - 10,000	58	59
More than 10,000	27	24

3. Local cost to be borne by region average annual \$1340 with distribution by income class as follows:

<u>Income Class</u> --Dollars--	<u>Percentage with</u> <u>Adjusted Gross Income</u>	<u>Percentage of</u> <u>Cost</u>
Less than 3,000	16	17
3,000 - 10,000	58	59
More than 10,000	27	24

B. Life, Health, and Safety

1. Provide 1 percent level of flood protection.

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ABBREVIATED ENVIRONMENTAL QUALITY ALTERNATIVE

Spring Canyon Watershed, Wyoming

Environmental Problems

The hazard of overland flooding restricts the productivity of natural resources and disrupts the social and economic pursuits of the residents in the watershed.

Wind and water erosion are depleting the quality of land in the watershed.

Intensive agricultural use of watershed resources has limited the opportunity to increase wildlife populations.

Component Needs

1. Provide flood prevention facilities.
2. Improve land quality by controlling erosion.
3. Increase wildlife populations by integrating wildlife habitat management and agricultural production management.

Elements of Environmental Quality Plan

1. Construct one floodwater retarding structure. Estimated cost of installation is \$610,000, including \$600,000 for construction and construction services and \$10,000 for land rights plus annual maintenance costs of \$775.
2. Apply needed conservation practices on all land in the watershed:
 - a) Develop conservation management plans for the 1,700 acres of riparian vegetation adjacent to the North Platte River. Plans will be formulated for proper livestock use of 1,500 acres and limited livestock use on selected tracts totaling 200 acres. On the 200 acres of selected tracts, joint management plans will be formulated for livestock and wildlife use. Estimated costs are \$2,000 annually for technical assistance, \$1,000 annually for land rights, and \$10,000 for installation of fences.
 - b) Develop management plans for proper livestock use of native vegetation on rangeland. Estimated cost is \$1,000 annually for technical assistance and \$10,000 for installation of needed practices.
 - c) Establish 10 miles of field windbreak in the cropland area. This will provide 30 acres to be managed for wildlife. Estimated cost of installation is \$20,000, including \$3,000 for tree planting and \$17,000 for land rights.

ABBREVIATED ENVIRONMENTAL QUALITY ALTERNATIVE (Continued)

Spring Canyon Watershed, Wyoming

- d) Develop conservation plans, including practices for crop and non-crop residue management, to adequately treat all cropland. Estimated cost is \$500,000 for installation plus \$50,000 for technical assistance.
3. Implement a plan to maintain road and canal side vegetation as undisturbed wildlife habitat. Annual cost of technical assistance is \$1,000. A capital investment of \$1,200,000 and annual operation, maintenance, and management costs of \$5,775 will be required to implement the Environmental Quality Plan.

Institutional Arrangements Available and Needed to Implement the Environmental Quality Plan

Legal entities exist who, in cooperation with the Lingle-Ft. Laramie Conservation District, could implement the Environmental Quality Plan. Existing legal entities include county government and the Lucerne Canal Company.

Programs and technical assistance are available to implement the Environmental Quality Plan.

1. Lingle-Ft. Laramie Conservation District program of technical assistance to landowners and operators in planning and applying conservation practices.
2. USDA, Soil Conservation Service, P.L. 566 program providing technical, cost-sharing, and loan assistance to plan and install small watershed projects.
3. USDA, Soil Conservation Service, Resource Conservation and Development Program providing technical, cost-sharing, and loan assistance to groups in planning and applying conservation measures.
4. USDA, Agricultural Stabilization and Conservation Service, administers programs providing cost-sharing assistance to individual landowners for application of conservation measures.
5. The Wyoming State Forestry Division of the State Land Office in cooperation with the USDA, Forest Service, under provisions of the Clarke-McNary Act of 1924, provide private landowners tree seedlings for windbreaks, shelterbelts, and forest plantings. Seedlings are obtained from the University of Wyoming through county extension agents.

In addition to available programs of technical, cost-sharing, and loan

WATERSHED WORK PLAN AGREEMENT

between the

Lingle-Ft. Laramie Conservation District
(Local Organization)

Lucerne Canal Company
(Local Organization)

(hereinafter referred to as the Sponsoring Local Organization)

State of Wyoming

and the

Soil Conservation Service
United States Department of Agriculture

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Spring Canyon Watershed, State of Wyoming, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Spring Canyon Watershed, State of Wyoming, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 5 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. Except as hereinafter provided, the Sponsoring Local Organization will acquire without cost to the Federal Government such land rights as will be needed in connection with the works of improvement. (Estimated cost \$9,750.)
2. The sponsoring local organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the sponsoring local organization and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation payments	45.1	54.9	0 ^{1/}

^{1/} Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Floodwater retarding structure and diversion channel	0	100	452,500

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Engineering Cost</u> (dollars)
Floodwater retarding structure and diversion channel	0	100	16,000

6. The Sponsoring Local Organization and the Service will each bear their costs for project administration, estimated at \$5,000 and \$69,300, respectively.
7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their lands.
8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.
14. No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Lucerne Canal Company By James E. Littel
Local Organization
Lingle, Wyoming 82223 Title President
Address Zip Code Date Jan 13, 1975

The signing of this agreement was authorized by a resolution of the governing body of the Lucerne Canal Company
Local Organization
adopted at a meeting held on Jan 13, 1975

Thomas Sloan P Lingle Wyo 82223
Secretary, Local Organization Address Zip Code

Date January 13 1975

Lingle-Ft. Laramie Conservation District
Local Organization

Lingle, Wyoming 82223
Address Zip Code

By James Castagnolo
Title Chairman

Date 1-16-75

The signing of this agreement was authorized by a resolution of the
governing body of the Lingle-Ft. Laramie Conservation District
Local Organization
adopted at a meeting held on 1-16-75

Wendell Ellis
Secretary, Local Organization

Date 1/16/75

Lingle Wyo. 82223
Address Zip Code

Appropriate and careful consideration has been given to the environmental
statement prepared for this project and to the environmental aspects
thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

Blaine D. Halliday
State Conservationist
1/17/75
Date

WATERSHED WORK PLAN

SPRING CANYON WATERSHED

Goshen County, Wyoming

Prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended.

Prepared by: Lingle-Ft. Laramie Conservation District
Lucerne Canal Company

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

October 1974

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SUMMARY OF PLAN

Spring Canyon Watershed is a rural agricultural area of 18,865 acres in Goshen County, southeastern Wyoming. This plan for watershed protection and flood prevention has been prepared by the Lingle-Ft. Laramie Conservation District and the Lucerne Canal Company. Technical assistance was provided by the Soil Conservation Service, and financial assistance for site investigations and engineering surveys was provided by the Wyoming Conservation Commission.

Water and Related Land Resource Problems

The principal water-related problem in the watershed is floodwater runoff produced by convective spring and summer rainstorms. Floodwaters and transported sediment and debris damage crops, cropland, farmsteads, irrigation works, and public utilities. Conservation land treatment problems are primarily overuse of range resources and inefficient irrigation water use on cropland.

Works of Improvement to be Installed

The plan includes conservation land treatment and structural flood prevention facilities. Conservation land treatment practices planned include planned grazing systems and livestock water facilities for rangeland, and conservation cropping systems and facilities for irrigation water management for cropland. Planned structural measures include a floodwater retarding structure, grade stabilization structures in Spring Canyon waterway, and a pipeline to divert reservoir release from the waterway to the Lucerne Canal. Project measures will be installed in a 5-year period. Structural measures will be completed by the end of the first year. The Lucerne Canal Company will install structural works under competitive contract.

Explanation of Installation Costs

Estimated project installation cost is \$1,043,130 including \$490,580 for conservation land treatment and \$552,550 for structural works. Public Law 566 funds will be used to finance \$572,800 and other funds \$470,330 of the estimated project installation cost.

Effects of Works of Improvement

Project measures will improve vegetative cover and enhance environmental values, protect soil resources, reduce average annual flood damages 95 percent, and permit restoration to former productivity of 85 acres of cropland. Project measures will improve and stabilize the local economy and allow sustained intensive agricultural use of the watershed.

Provisions for Operation and Maintenance

The Lucerne Canal Company will be responsible for installation, operation,

and maintenance of structural works. Average annual operation and maintenance costs are estimated to be \$500. Inspection of structural works will be performed annually as well as after every major storm. Inspection reports will be provided the Soil Conservation Service. Operation and maintenance of land treatment practices will be the responsibility of the landowner or lessee.

Average Annual Project Benefits and Costs

Average annual project benefits are estimated to be \$38,220. Primary and secondary benefits of the structural works in reducing floodwater damage are estimated to be \$37,870. The average annual cost of structural works is \$32,100. The project benefit-cost ratio is 1.2:1.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

Spring Canyon Watershed encompasses an area of 18,865 acres or 29.5 square miles in Goshen County, southeastern Wyoming. The watershed is in the Missouri Water Resource Region and is a left bank tributary to the North Platte River. Spring Canyon is the principal watershed drainage; however, smaller unnamed tributaries and bottomlands of the North Platte River make up a large portion of the watershed.

Spring Canyon Watershed is a rural agricultural area. Lingle, 1970 population 446, is the only town in the watershed. Scottsbluff, Nebraska, 40 miles east of the watershed, is the nearest town offering a variety of trade facilities and specialized services. Cheyenne and Casper, Wyoming, are within 150 miles; and Denver, Colorado, the nearest large urban center, is within 200 miles.

The demographic characteristics of Goshen County are similar to those of the watershed. The 1970 population of Goshen County was 10,885 with a population density of 4.9 persons per square mile. Rural population in 1970 constituted 61 percent of the county population and was divided equally between rural farm and rural non-farm. Goshen County is an area of decreasing population. County population decreased 8.8 percent from 1960 to 1970 with rural population decreasing approximately 1,100 persons or 14.3 percent, while urban population increased 1.2 percent. ^{1/} The watershed and Goshen County are typical of the western portion of the Missouri Water Resource Region, particularly in relation to low population densities, decreasing rural populations, and an agricultural economic base.

Spring Canyon drainage is a dry wash with ephemeral flow. Runoff flows south and southwesterly onto a broad alluvial wash or fan. There are about 5 miles of defined waterway from the upper part of the watershed to just below the Interstate Canal. Below this point no waterway can be defined, and flows spread across the alluvial fan. (See project map.)

1/ U. S. Bureau of the Census, U. S. Census of Population: 1970 Number of Inhabitants, Final Report PC(1)-A52 Wyoming, U. S. Government Printing Office, Washington, D.C. 1970.

The 5 miles of defined waterway has an average width of 20 feet, but varies from near zero to 100 feet. The waterway depth averages about 2 feet, and slopes vary from 3 percent in the upper reaches to 1 percent in the lower reaches. The defined waterway from the Interstate Canal to the upper reaches of the watershed serves as an access trail. The trail is ungraded with access privately controlled immediately above the Interstate Canal.

Vegetation in the waterway is very sparse. Vegetation is composed of about 50 percent perennial grasses, 25 percent annual broadleaf weeds, and 25 percent annual grasses.

The head of Spring Canyon is on Pine Ridge, an erosional remnant of the Arikaree formation rising nearly 900 feet above the surrounding valley floor. Elevations in the watershed range from about 4,100 feet above mean sea level at the North Platte River to about 5,000 feet on Pine Ridge. Topography of the watershed is generally rolling in the upland areas. Alternate ridges and swales originating on Pine Ridge lead into low, rolling hills, alluvial-colluvial fans, and valley terraces near the lower reaches of the watershed. The alluvial-colluvial fans and valley terraces are areas of intensively farmed irrigated land. Slopes range from near vertical escarpments along the canyon walls in the upper part of the watershed to near level or gently sloping fans and terraces in the lower part of the watershed.

The Brule and Arikaree formations of Oligocene and Miocene Age respectively comprise the bedrock geologic formations in the watershed. The Brule is a flesh-colored to buff siltstone that erodes quite readily. It is overlain unconformably by the basal Arikaree, which is a fairly thick, well-cemented conglomerate in this watershed.

The Arikaree is hard and quite durable, and occurs in the upper portions of the watershed. The capping effect of the Arikaree over the softer Brule results in high, relatively flat-topped benches dissected by deep canyons with steep walls.

The Brule was deposited in a large basin containing fresh water lakes, mud flats, and slow, meandering streams. Uplift of the Laramie Range rejuvenated streams resulting in transportation and deposition of the coarse conglomeritic Arikaree formation. The area was then upwarped and faulted, although no major faults are discernible within the watershed. The uplift caused an increase in the rate of erosion which has modified the topography to its present condition.

There are no known commercially mineable mineral deposits in the watershed.

Soils in the lower part of the watershed adjacent to the North Platte River occur in association with river wash. The soils are excessively drained, hummocky, sandy, and gravelly. Soils found higher in the floodplain of the North Platte River are nearly level, deep, sandy, or loamy soils.

Soils on alluvial fans such as the Spring Canyon floodplain are nearly level, deep, loamy sands, and nearly level, fine sandy loam underlain by loose sand and gravel. Along the upper margins of the alluvial fans are moderately steep to steep high terrace rims with very gravelly soils.

Most of the soils in the upper watershed are moderately steep to steep, shallow, fine sandy loam underlain by soft sandstone. Areas of nearly level to sloping, deep, fine sandy loam soils can be found in the upper watershed.

The upper part of the watershed is primarily rangeland, and the lower part is irrigated cropland intermingled with small areas of rangeland. Land capability classes of the rangeland are principally VI and VII. ^{2/} Approximately 30 percent of the upper part of the watershed is topographically steep ridges and valley walls composed of shallow loamy (80 percent) and very shallow (20 percent) range sites. Ecological condition of the vegetation on the shallow loamy range sites in this area is about 20 percent excellent, 60 percent good, and 20 percent fair. As ecological condition on shallow loamy sites deteriorates, bunchgrasses (bluebunch wheatgrass, Agropyron spicatum, and little bluestem, Andropogon scoparius) are replaced by blue grama grass, Bouteloua gracilis, and threadleaf sedge, Carex filifolia. Ecological condition of the vegetation on the very shallow range sites of the steep ridges and valley walls is about 50 percent excellent and 50 percent good. As ecological condition on very shallow sites deteriorates, bunchgrasses (bluebunch wheatgrass, Agropyron spicatum, and little blue stem, Agropyron scoparius) become less dominant with juniper, Juniperus spp., and red threeawn, Aristida longiseta, becoming more dominant.

Approximately 70 percent of the rangeland is bench areas topographically below steep ridges and valley walls and is composed of loamy (to percent) and shallow loamy (30 percent) range sites. Ecological condition of the vegetation on loamy range sites in this area is about 5 percent excellent, 30 percent good, 60 percent fair, and 5 percent poor. As ecological condition on the loamy range site deteriorates blue grama grass, Bouteloua gracilis, threadleaf sedge, Carex filifolia, and buffalo grass, Buchloe dactyloides, become more dominant as needleandthread grass, Stipa comata, and western wheatgrass, Agropyron smithii, become less dominant. Ecological condition of the vegetation on shallow loamy sites is about 15 percent excellent, 30 percent good, 50 percent fair, and 5 percent poor. Vegetative changes with changes in ecological condition are the same as those described for the shallow loamy site discussed above.

Land capability classes of the irrigated land are: 20 percent Class I, 50 percent Class II, 20 percent Class III, and 10 percent Class IV. Flood damage occurs mainly on Class II and Class III irrigated lands. ^{3/} Productivity of irrigated cropland in the watershed is among the highest in the state. Well-drained soils and an adequate growing season provide the

^{2/} USDA, Soil Conservation Service with Wyoming Agricultural Experiment Station, Soil Survey Goshen County, Wyoming, Southern Part, page 48-50, U. S. Government Printing Office, Washington, D.C., November 1971.

watershed with a high potential for producing agricultural commodities suited to temperate climatic conditions. Principal crops produced are corn, sugar beets, dry beans, and alfalfa. Projected potential production levels by 2000 are 28,9 tons corn silage, 32.7 cwt. beans, 29 tons sugar beets, and 8.7 tons alfalfa hay.

Land use for the 18,865 acres in the watershed is: Irrigated land, 5,720 acres; dry crop, pasture, and hayland, 440 acres; rangeland, 11,855 acres; and other uses, 850 acres. Other uses include roads, highways, and railroad rights-of-way, irrigation canals, farmsteads, and the town of Lingle.

Climatic conditions are subject to wide seasonal extremes. Temperature extremes range from a maximum of about 107° F. to a minimum of about 33° below zero. The growing season averages 147 days. The average date of the last killing frost (28° F.) is May 6, and the first killing frost October 1. Climatic data are taken from records of the Torrington weather observation station about 10 miles east of the watershed.

3/ Ibid, pages 48-50.

Land capability class indicates, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. Classes are generally defined:

Class I - Soils with few limitations that restrict their use.

Class II - Soils with moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III - Soils with severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV - Soils with very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V - Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI - Soils with severe limitations that make them generally unsuited for cultivation and limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII - Soils with very severe limitations that make them unsuited for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII - Soils and land forms with limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife habitat, or water supply, or to aesthetic purposes.

Mean annual precipitation in the watershed is about 13 inches and ranges from about 8.5 to 22.0 inches. Approximately 63 percent of annual precipitation occurs from April 1 to July 31. Summer rainstorms are usually short duration, intense thunderstorms. The average total seasonal depth of fresh fallen snow is only about 33 inches. There is very little accumulation of snowpack. The major portion of snow is lost to evaporation.

The major source of irrigation water is the North Platte River. Irrigation water diverted from the North Platte River is delivered to irrigated land in the watershed in two primary canals--the Interstate and Lucerne. The Interstate Canal delivers irrigation water to approximately 118,000 acres of irrigated land in southeastern Wyoming and western Nebraska including about 1,700 acres in the watershed. The Interstate Canal traverses the watershed southeasterly in a meandering manner crossing Spring Canyon in a large flume. The Lucerne Canal serves approximately 4,400 acres, including 4,000 acres of lower lying lands in the watershed. The canal crosses the watershed in a southeasterly direction ending at Rawhide Creek. The canal crosses the alluvial-colluvial fan of Spring Canyon, and no provisions for cross-drainage flows have been provided.

No significant storage or other beneficial use of surface water runoff from Spring Canyon has been made. Groundwater resources in the upper part of the watershed are limited. Wells generally produce less than 50 gallons per minute and are used primarily for stock water. Wells have been developed in the lower part of the watershed and draw from the water table of the North Platte River. Wells in the lower part of the watershed generally have a capacity of about 1,000 gallons per minute and are used for irrigation of lands not served by surface water and for supplementary water to other irrigated land.

Economic Data

Economic activity in the watershed is almost entirely agriculturally related. The major type of agricultural enterprise is the irrigated farm-ranch. Presently, there are 46 farm-ranch units operating in the watershed. Farm-ranch units in the watershed are mostly family operated. The average size operating unit in Goshen County is 1,505 acres with approximately 175 acres irrigated and 1,330 acres rangeland, dryland, and other uses. In the county, the average value of land and buildings per farm is about \$131,341. Average value of farm products sold is about \$29,468 per farm with approximately one-third of the revenue derived from crops and two-thirds from livestock and livestock products. ^{4/}

Land ownership in the watershed is: Federal, 1,210 acres (6.4 percent), state, 1,165 acres (6.2 percent), and private, 16,490 acres (87.4 percent). Public or federal land is rangeland in the upper part of the watershed and is managed by the Bureau of Land Management under section 15 of the Taylor Grazing Act.

^{4/} U. S. Bureau of the Census, Census of Agriculture, 1969, Volume 1 Area Reports, Part 40 Wyoming.

The current value of privately-owned land in the watershed varies from \$50 to \$75 per acre for rangeland, approximately \$100 per acre for dry cropland, and from \$400 to \$500 per acre for irrigated land.

Crops are produced primarily on irrigated land. Principal crops are corn, dry beans, sugar beets, and alfalfa. Average crop yields per acre are: Corn, 15.7 tons of silage; dry beans, 19 cwt.; sugar beets, 17.2 tons; and alfalfa hay, 3.8 tons. Beef cattle is the primary livestock enterprise. Cow-calf operations and a few fat cattle feeding operations are the major beef production activities.

Transportation facilities in the watershed are excellent. Nearly all farms and ranches have all-weather access to state and federal highways leading to commercial and market centers. U. S. Highway 85 leads in a northeasterly direction from Lingle. U. S. Highway 26 traverses the watershed from northwest to southeast through Lingle and serves the watershed as the major market road. Several county and township roads provide an excellent transportation network for local and farm machinery traffic. A track of the Burlington-Northern Railroad parallels U. S. Highway 26 providing transportation facilities for farm goods to and from subregional and regional trade centers. (See project map.)

The town of Lingle is the local community center and offers limited trade facilities. Torrington, 10 miles east on U. S. Highway 26, serves as the local trade center. The major trade center for the watershed and surrounding area is Scottsbluff, Nebraska, approximately 40 miles east.

Mean income of rural farm families in Goshen County is below state and national mean family income. Mean income of rural farm families in Goshen County in 1970 was \$8,122 compared to \$9,482 state-wide and to a mean income of all Wyoming families of \$10,127. Nationally, mean income of rural farm families in 1970 was \$8,795 and of all families, \$10,999. ^{5/} Mean income of rural farm families in Goshen County in 1970 was 72 percent of mean income of all families in the nation. Approximately 14.4 percent of all Goshen County families had income less than poverty level in 1970. Per capita income as a percent of national average for the Bureau of Economic Analysis area, which includes the watershed, is projected to decrease by 1980 and to increase slowly to a level lower than present by 2000. ^{6/}

The civilian labor force in Goshen County in 1970 was 4,204 persons. The county unemployment rate was 4.0 percent compared to 4.8 percent state-wide. ^{7/}

Approximately 17.6 percent of male and 39.5 percent of female employed

^{5/} U. S. Bureau of the Census, Census of Population: 1970 General Social and Economic Characteristics, Final Report PC(1)-C52, Wyoming.

^{6/} U. S. Water Resource Council, 1972 OBERS Projections, Vol. 1, Concepts, Methodology, and Summary Data, p. 51.

^{7/} Census of Population: 1970 General, Social, and Economic Characteristics, Op. Cit.

civilians in Goshen County are underemployed. Approximately 22.9 percent of employed man-years of labor are unutilized because of underemployment. 8/

Agricultural employment in Goshen County was about 25 percent of total county employment in 1970.

Fish and Wildlife Resources

Spring Canyon Watershed provides habitat for a limited variety of big game, upland game, and small animal species. Wildlife habitat in the watershed varies with elevation, soil types, plant communities, and land use.

Big game animals found in the watershed include antelope, mule deer, and whitetailed deer. Mule deer are found throughout the watershed; however, primary mule deer habitat is provided in the upper part of the watershed where brush covered draws and steep slopes provide fair habitat dominated by ponderosa pine, Pinus ponderosa, with an understory consisting of scattered amounts of bitterbrush, Purshia tridentata, mountain mahogany, Cercocarpus montanus, and big sagebrush, Artemisia tridentata. Antelope occupy upland areas. The bunch grass-sagebrush composition on bench areas in the upper part of the watershed provides fair antelope habitat with needleandthread grass, Stipa comata, big sage, Artemisia tridentata, and silver sage, Artemisia cana, as the dominant plants. Whitetailed deer inhabit low lying areas adjacent to the North Platte River where cottonwood, Populus sargentii, with a thick understory of silver sagebrush, Artemisia cana, big sagebrush, Artemisia tridentata, rose, Rosa spp., and willow, Salix spp., provide good habitat.

Small animals and upland game in the watershed include pheasant and cottontail rabbit. Irrigated lands with grassy irrigation ditch systems and crop residue provide primary habitat for small animals and upland game; however, cottontail rabbits are found throughout the watershed.

Game animal resources in the watershed are utilized by the hunting public under regulations established by the Wyoming Game and Fish Commission. Access to game or other wildlife resources is possible using existing roads and trails; trespass consent of landowners is required on all but state and federally-owned land.

Game animal population and harvest data for the watershed are not available. Population and harvest data are tabulated only for much larger areas such as a game management unit, county, or district. Consultation with the Wyoming Game and Fish Commission indicates a detailed analysis of animal populations is not warranted.

Small animals and predators found in the watershed include coyote, fox, burrowing animals, birds of prey, song birds, migratory waterfowl, and

8/ Ronald E. Kampe and William A. Lindamood, Underemployment Estimates by County, United States, 1960. Agricultural Economic Report No. 66, Economic Research Service, Washington, D.C., October 1969.

fur bearers including mink, beaver, and muskrat. Furbearers occupy the marshy areas and stream channels of the North Platte River. Trapping seasons and regulations for taking furbearers are established by the Wyoming Game and Fish Commission. Migratory waterfowl seasonally inhabit portions of the North Platte River. Regulations and seasons for the hunting of migratory waterfowl are established by the Wyoming Game and Fish Commission in cooperation with the Flyway Council for the Central Flyway.

Currently, there are no fisheries in the drainage area, and there is only a limited fishery for trout and channel catfish in the North Platte River. Information regarding use of the fishery is not available, although seasons and regulations are established for the area by the Wyoming Game and Fish Commission.

The 1973 edition of "Threatened Wildlife of the United States" ^{9/} published by the U. S. Department of Interior, Bureau of Sport Fisheries and Wildlife, lists two species that inhabit the area including Spring Canyon Watershed: the American Peregrine Falcon (Falco peregrinus anatum); and the Ferruginous Hawk (Buteo regalis) listed as "undetermined." No other species listed in this reference is known to inhabit the watershed.

Recreational Resources

Outdoor recreation in the watershed is limited. Natural resources offer limited opportunity for outdoor recreational use. There are no public recreation areas or commercial outdoor recreation enterprises in the watershed. The watershed has limited potential for the development of recreation facilities or increased recreation use. The comprehensive outdoor recreation plan, prepared by the State of Wyoming, lists no plans for development in the watershed.

Recreation activity is primarily associated with wildlife resources including the hunting of big game, upland game, and waterfowl. There is a limited amount of fishing and rock hunting in the watershed. Access for recreation use requires landowner permission on private land.

Archeological and Historic Values and Unique Scenic Areas

Mr. Paul Westedt, State Historic Preservation Officer, reviewed the watershed area and responded, "No presently known historic or archaeologic values would be affected by the indicated area of actual construction. However, the site is only about three miles distant from the route of the Oregon Trail and the historically rich North Platte River. Especial vigilance for archaeologic values during the construction period are indicated. In case of discovery of any ancient human activity, construction should be halted

^{9/} Threatened Wildlife of the United States, 1973 Edition; Resource Publication 114, March 1973. Compiled by Office of Endangered Species and International Activities, Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior. Published by Bureau of Sport Fisheries and Wildlife.

and this office notified. Response would be immediate so as not to delay work more than absolutely necessary." 10/

The National Register of Historic Places and the Federal Register notice of February 19, 1974, and all succeeding supplements make no reference to historic places in the watershed.

The State Archeologist, Dr. George Frison, completed an evaluation of archeological resources in the watershed and reported, "We found one site which is located in the S.E. $\frac{1}{4}$ of section 26, T26N, R63W. The site, a stone circle and quartzite quarry, is located far above the proposed high-water level and away from the dam construction area. It does not appear to be in danger and I am making no recommendations for salvage or preventative actions. The site will be added to the Wyoming Archaeological Site Catalogue." 11/

In the event that previously unknown cultural resources are encountered during construction, the National Park Service Archeological Center will be notified and provided adequate time to protect and preserve any discovered data or materials.

No reference to unique scenic value in or near the watershed is made in the Wyoming Comprehensive Outdoor Recreation Plan.

Soil, Water, and Plant Management Status

Land use in the North Platte River Valley has evolved because of economic factors, climatic conditions, productivity of soils, and water resource developments. The failure of early settlers to make a living by ranching resulted in attempts to increase hay and pasture production through irrigation. Small irrigation water supply systems, such as the Lucerne Canal built in 1893, was the first effort to organize and manage irrigation water on a cooperative basis. Pathfinder Dam and the Interstate Canal, built by the Bureau of Reclamation in 1905, was the first federal project to provide irrigation for a large acreage of the North Platte Valley. The development of irrigation systems initiated more intensive agriculture. Over time, economic conditions forced operators to become more efficient; and small grain, corn, and introduced forage species replaced irrigated hay and pasture. Presently, only a small acreage of the least productive irrigated land remains as hay and pasture. Past trends and anticipated increases in technology indicate that remaining irrigated hay and pasture will be converted to intensively farmed cropland.

Dryland farming in the watershed is economically marginal under present conditions. Above average precipitation in the 1920's resulted in the development of dryland farming. Drought, wind erosion, and economic

10/ Correspondence from Mr. Westedt to Mr. Blaine O. Halliday, State Conservationist, Soil Conservation Service, Wyoming, on March 6, 1974.

11/ Correspondence from George M. Zeimens, Assistant State Archeologist, to Soil Conservation Service, Wyoming, on July 3, 1974.

conditions in the 1930's forced abandonment of most dry cropland. Dry cropland remaining after 1940 has been seeded with permanent grass or converted to irrigated cropland. Presently, there are only about 120 acres of dry cropland in the watershed.

Floods from Spring Canyon have caused abandonment of approximately 85 acres of cropland in the floodplain. Frequent damage to crops and the on-farm irrigation system caused continued farming of the acreage to be infeasible.

Water resource developments and movements to more intensive farming were paralleled by increased use of farm conservation practices. The Lingle-Ft. Laramie Conservation District was formed in 1946. Presently, 43 of the 46 operating units covering 91 percent of the land in the watershed are cooperators of the Conservation District. Basic conservation plans have been prepared by 40 cooperators covering 88 percent of the watershed. Approximately 80 percent of the planned practices included in basic conservation plans have been applied by the cooperators. Adequate conservation land treatment has been accomplished on about 50 percent of the cropland, 40 percent of the pasture and hayland, and 30 percent of the rangeland in the watershed.

Rural fire protection for the watershed is available. Fires are kept within the state's fire control goals.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Treatment

The most significant land and water management problem in the watershed is improper use of land and water resources causing accelerated soil erosion and increasing the amount of water loss through runoff. In the upper part of the watershed grazing overuse has caused deterioration in ecological condition of rangeland vegetation and accelerated soil erosion. (See WATERSHED RESOURCES - ENVIRONMENTAL SETTING.) Average annual herbage production (pounds) and annual soil movement (tons per acre per year) are tabulated by dominant range site for the rangeland on steep ridges and valley walls and on bench areas:

Steep Ridges and Valley Walls (30 percent)

Range site	Ecological condition class			
	Excellent	Good	Fair	Poor
Shallow loamy (80%)	(20%)	(60%)	(20%)	
Soil movement	1	3	4	8
Herbage production:	900	750	300	250
Very shallow (20%)	(50%)	(50%)		
Soil movement	2	4	6	12
Herbage production:	450	350	150	100

Bench Areas (70 percent)

Range site	Ecological condition class			
	Excellent	Good	Fair	Poor
Loamy (70%)	(5%)	(30%)	(60%)	(5%)
Soil movement	.5	1	2	5
Herbage production	1,300	1,000	450	400
Shallow loamy (30%)	(15%)	(30%)	(50%)	(5%)
Soil movement	1	2	3	6
Herbage production	900	750	300	250

The average rate of soil movement on rangeland is about $2\frac{1}{4}$ tons per acre per year, and average herbage production is about 620 pounds per acre annually.

In the cropland area, inadequate irrigation facilities and field irrigation systems cause inefficient use of irrigation water and accelerate soil erosion. On-farm irrigation efficiency is presently about 40 percent. Soil movement, both wind and water, on cropland averages about 8 tons per acre annually.

Flood hazards have caused installation of some land treatment measures to be impractical. In other cases, flood damage has affected the economic ability of landowners to apply needed practices.

Floodwater Damage

The principal water-related problem in the watershed is floodwater runoff. Convective spring and summer rainstorms in the upper part of the watershed produce runoff of flood magnitude. Floodwaters and transported sediment and debris damage crops, farmstead properties, irrigation works, and public utilities in the floodplain.

Major floods have occurred six times in the past 30 years. The most recent of the major damaging floods occurred in 1955 and 1969. Flood damages are incurred about every other year. Because of the convective nature of the rainstorms, more than 95 percent of the floods occur in the months May through September. July is the most probable month for a damaging event.

The floodplain of Spring Canyon covers approximately 1,140 acres affecting 46 operating units and includes 1,050 acres of cropland, eight farmsteads, U. S. Highway 26, and the Lucerne Canal. There are 85 acres of previously cropped land in the floodplain which have been abandoned because of flood hazard.

The flood in 1955 was an infrequent event with about a 1 percent chance of occurrence. The storm flooded approximately 1,050 acres of intensively farmed cropland, breached the Lucerne Canal causing a delay in delivery of irrigation water to 4,000 irrigated acres, caused damage to eight farmsteads, and inundated U. S. Highway 26 causing a delay and detour of traffic. Flood



PHOTO COURTESY OF THE GUIDE

Flooding on U.S. Highway 26, 1955.

damage began at the point where the Spring Canyon channel loses definition just below the Interstate Canal. Floodwater entering the Lucerne Canal overtopped and washed out the canal bank, flooding cropland between the Lucerne Canal and U. S. Highway 26 in several locations between Spring Canyon and Lingle. Below the highway at Spring Canyon, floodwaters damaged crops and farmstead properties before reaching the North Platte River.

Projections of land use, crops, yields, and highway traffic indicate that damage from a 1 percent chance event in the future would be about \$200,000.

The flood in 1969 was a 20 percent chance event. The storm flooded approximately 300 acres including 255 acres of intensively farmed cropland. The flood caused damage to three farmsteads, breached the Lucerne Canal causing delay in delivery of irrigation water to 4,000 irrigated acres, and inundated U. S. Highway 26 causing a delay in traffic. The damage characteristics and route of flooding was similar to the 1955 flood, but on a smaller scale. Damage caused by a 20 percent chance event representative of the evaluation period is estimated to be approximately \$70,000.

Small floods which occur more frequently do not cross U. S. Highway 26 but do cause operational problems and minor damage to the Lucerne Canal. The smaller, more frequent floods affect land use in the floodplain area between the Interstate Canal and U. S. Highway 26. The hazard of frequent floods has caused the abandonment of 85 acres of previously cropped farmland. The value of this land is about \$200 per acre.

Total average annual damage in the Spring Canyon Watershed is estimated to be \$36,345. (See table 5.) Estimated average annual floodwater damage is \$32,970. Crop and pasture floodwater damage from decreased crop yields, decreased crop quality, and increased production costs is estimated to be \$24,770. Other agricultural floodwater damage is estimated at about \$8,100 and includes damage to farmsteads, the Lucerne Canal, and crop losses due to delay in delivery of irrigation water to 4,000 irrigated acres in 24 farm units served by the Lucerne Canal. Non-agricultural floodwater damages are estimated to be about \$100 arising from damage to U. S. Highway 26 and delay and detour of traffic.

Sediment damages in Spring Canyon are closely associated with floodwater damage. Sediment damages cause decreased crop quality, increased crop production costs, increased operation and maintenance cost of the Lucerne Canal, and increased highway maintenance and cleanup. Average annual damage attributed to sediment is estimated to be approximately \$910.

Indirect damages are estimated to be \$2,465. Indirect damages include additional time required to irrigate flooded lands, additional time required to perform cultural operations, and the cleanup of flood-transported debris. (See table 5.)

Economic and Social

Mean income of rural farm families in Goshen County is below state and national mean family income. Underemployment of the civilian labor force in the county is high. Goshen County is an area of decreasing population.

County population decreased 8.8 percent from 1960 to 1970 with rural population decreasing approximately 1,100 persons or 14.3 percent, while urban population increased 1.2 percent. (See "Economic Data" presented in previous section.)

Selected characteristics of all Goshen County farms and Economic Class 1-5 farms are presented in the following tables. The percent tenancy of farms in the county is 27 percent. The average age of farm operators is 50.3 years for all farms in the county and 49.9 years for operators of Class 1-5 farms. The average age of all operators increased about 1 year from 1964 to 1969. About 86 percent of all farms are Economic Class 1-5 farms with sales of \$2,500 or more. About 83 percent of Class 1-5 farms in the county are individual or family farms employing 1½ man-years of hired labor or less per year.

Selected Characteristics of All Goshen County Farms ^{a/}

<u>Farm Tenure</u>	<u>Percent of Farms</u>
Full owner	38
Part owner	34
Tenants	27

Age of Farm Operators (Percent of Operators)

Under 25 years	3
25 - 34 years	9
35 - 44 years	20
45 - 54 years	27
55 - 64 years	28
65 years and over	12
Average age	50.3 years

Percent of Farms by Economic Class

Class 1 - Sales of \$40,000 and over	- 18
Class 2 - Sales of \$20,000 to \$39,999	- 27
Class 3 - Sales of \$10,000 to \$19,000	- 20
Class 4 - Sales of \$ 5,000 to \$ 9,999	- 12
Class 5 - Sales of \$ 2,500 to \$ 4,999	- 9
Class 6 and other categories	- 14

a/ Census of Agriculture, 1969, Volume 1 Area Reports, Parts 40, Wyoming Op. Cit.

Selected Characteristics of Economic Class 1-5 (Sales over \$2,500) -
Farms in Goshen County ^{a/}

Average size of farm - 1,709 acres

Average value of land and buildings per farm - \$147,367

Average market value of all agricultural products
sold per farm - \$33,971

Farm Tenure (Percent of Farms)

Full owner	- 34
Part owner	- 39
Tenants	- 27

Farms by Type of Organization (Percent)

Individual or family	- 83
Partnership	- 12
Corporation	- 4
Other	- 1

Age of Farm Operators (Percent of Operators)

Under 25 years	- 2
25 - 34 years	- 10
35 - 44 years	- 21
45 - 54 years	- 28
55 - 64 years	- 27
65 years and over	- 12

Average age - 49.9 years

a/ Ibid.

PROJECTS OF OTHER AGENCIES

The Interstate Canal, which crosses the watershed in a southeasterly direction, was built by the Bureau of Reclamation in 1905. The Interstate Canal delivers irrigation water to approximately 118,000 acres on the north side of the North Platte River in eastern Wyoming and western Nebraska. The Interstate Canal crosses Spring Canyon in a flume. The structure temporarily constricts flood flows. The Pathfinder Irrigation District administers the canal.

The Lucerne Canal is a locally-owned and operated irrigation ditch serving about 4,400 acres including 4,000 acres in the watershed. The Lucerne Canal was built in 1893 by the Lucerne Canal Company to divert irrigation water from the North Platte River. The canal passes through the watershed approximately adjacent to U. S. Highway 26. Controlled floodwater releases of Spring Canyon Dam will discharge into the Lucerne Canal. (See project map.)

PROJECT FORMULATION

Efforts to develop a plan for watershed protection and flood prevention in Spring Canyon began in October 1961 when local sponsors submitted an application to the Secretary of Agriculture for planning assistance under authority of PL 566. Following the application for assistance, preliminary investigations were conducted to estimate the physical and economic feasibility of pursuing solutions to the problems outlined in the watershed application. A preliminary investigation report, published in June 1963, indicated a project was not economically feasible. Continuing floods and demands of the sponsors caused further study of watershed problems and possible solutions. A potentially feasible watershed project was identified in a second preliminary investigation report published in December 1969. Authorization to proceed with planning works of improvement was received in July 1970. After planning efforts had begun on Spring Canyon Watershed, the sponsoring organization and interested parties amended the application for planning assistance. The Secretary of Agriculture was requested to include an adjacent drainage and areas between drainages in the authorization for planning assistance. Investigation revealed that a feasible solution to water-related problems in the added drainage was not available. A second amendment to the application for planning assistance was submitted to delete the added hydrologic area.

Activity of the project sponsors to coordinate planning activity, carry on correspondence, and provide public information during project formulation and planning was directed by a steering committee elected by and from residents of the watershed area. The steering committee called meetings of the sponsors, state and federal agencies, and interested parties as needed to formulate project objectives, assemble basic data, coordinate planning efforts, formulate and discuss alternative plans, and make decisions during the planning process. Notice of meetings was provided by correspondence and publishing meeting notices in local newspapers. During plan formulation the steering committee advertised and held two formal public meetings to discuss and consider project alternatives and effects. At each meeting, formal and informal public comments were solicited on plan alternatives, project effects, or other considerations.

The Missouri River Basin Comprehensive Framework Study identified Spring Canyon Watershed as a potentially feasible project area for development of flood prevention measures.

Objectives

The project objective outlined by the project sponsors is to formulate the least costly plan for watershed protection and flood prevention. Project sponsors desire to achieve a level of flood prevention that would reduce the frequency of significant flood damage to 1 year in 10.

Land treatment to provide watershed protection and reduce floodwater runoff was established as the first increment in planning to reduce floodwater damages. The objective of land treatment includes striving for a level of

production consistent with the potential of the area by reducing soil loss to a level tolerable for sustained land use and by achieving increased efficiency in the use of irrigation water. Goals for adequate land treatment during the project installation period include: (1) Develop basic conservation plans for all lands in the watershed area; (2) install 75 percent of needed conservation practices on the rangeland in the watershed; (3) install 75 percent of needed conservation practices on the pasture and hayland in the watershed; and (4) install 90 percent of needed conservation practices on the cropland in the watershed.

Sponsors' objectives include the investigation of opportunities for multipurpose development and minimization of potentially adverse impacts on environmental values of the area.

Environmental Considerations

In formulating project alternatives emphasis was placed on planning land treatment measures compatible with habitat requirements of wildlife in the area. Alternative plans were formulated considering flood protection to farmsteads and utilities as higher priority protection than protection of agricultural values. In formulating alternatives, designs were considered which would not displace people and would minimize inconvenience. Opportunity was provided the public to identify environmental values to be considered in plan formulation, weigh impacts of alternative plans, and provide recommendations to minimize adverse impacts.

Alternatives

Land treatment practices, structural measures, and management systems were considered in formulating a plan to meet sponsors' objectives. The initial consideration of possible alternatives included a judgment of practical feasibility and project effect.

Conservation land treatment of the watershed without structural works would produce the same increases in vegetation and reductions in erosion described later for the recommended project. Conservation land treatment alone would reduce flood damage about 1 percent. Combining either floodplain management or systems of flood proofing with intensive land treatment would not meet flood damage reduction objectives because of the inability to outlet floodwater.

Investigations were made of combinations of land treatment and structural measures including increased channel capacity and floodwater detention. Plans formulated to construct a floodway to transmit floodwaters through the floodplain to the North Platte River revealed installation costs greater than economically justifiable, that there would be induced downstream damage, and adverse impacts greater than evident with floodwater detention. Investigation of floodwater detention in combination with land treatment revealed opportunity to meet sponsors' objectives for reducing floodwater damage with minimum adverse impact.

Project alternatives were explained and a discussion of probable effects conducted at a public meeting to allow project sponsors and interested parties determine which alternative to pursue in detailed plan formulation. Consensus agreement was reached to pursue a combination of land treatment and floodwater detention.

Detailed formulation of a plan for land treatment and floodwater detention included a study of opportunity to incorporate a permanent conservation pool in the floodwater detention structure. A permanent conservation pool was considered to enhance wildlife management and establish a fishery.

The U. S. Bureau of Sports Fisheries and Wildlife investigated the potential for development and determined minimum requirements for establishing a worthwhile fishery. Minimum requirements of a conservation pool could not be met because of intermittent and unpredictable flows and anticipated high seepage losses.

Land treatment practices incorporated in the plan are based on an inventory of conservation needs in the watershed. Practices included are required to meet sponsors' objectives to protect and develop the soil and water resources of the total watershed. Land treatment practices included are based on land capability, land use, and environmental concern.

State-owned lands in the watershed area were considered as private lands in formulating practices for conservation treatment. Needed conservation practices on state land are included in the basic conservation plan of the lessee.

Federal land in the watershed is administered by the Bureau of Land Management under section 15 of the Taylor Grazing Act. Practices for conservation treatment on federal land were formulated on the same basis as private lands and incorporated in the basic conservation plan of the lessee.

A combination of land treatment and floodwater detention facilities was selected by watershed sponsors because it is the only economically feasible means of meeting project objectives and because beneficial environmental effects outweigh adverse effects.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Land treatment to be accomplished during the 5-year project installation period will provide adequate treatment on approximately 4,720 acres. Approximately 7,950 hours of technical assistance will be needed to conduct resource inventories, develop plans, and provide engineering assistance. New basic conservation plans will be prepared on six operating units covering 2,285 acres, and basic conservation plans will be revised on 14 operating units covering 5,565 acres.

Approximately 3,650 acres of rangeland will receive adequate conservation

treatment during the installation period. Conservation practices for rangeland are planned to achieve proper grazing use. Typical conservation practices include planned grazing systems and livestock water facilities.

Adequate conservation treatment will be accomplished on approximately 640 acres of cropland in the watershed during the installation period. Conservation practices planned for the cropland area are primarily conservation cropping systems and facilities for proper irrigation water management.

Conservation practices planned for pasture and hayland in the watershed will adequately treat 427 acres during the installation period. The primary pasture and hayland conservation practices needed are pasture and hayland planting and management.

The acres listed above as adequately treated are lands to be used within their capability and on which the planned conservation practices are essential to their protection and planned improvement. Lands adequately treated are only those acres on which adequate treatment is to be achieved during the installation period. However, estimated costs listed in table 1 include costs for technical assistance and installation of practices throughout the watershed as elements of practice systems which when completed in total constitute adequate treatment.

Conservation practices planned for installation on state land will be applied by the lessee. The present policy of the state land administering agency is to allow improvement of state land without state financial participation. Practices applied on state land will be filed with the State Land Board by the lessee.

Practices planned on federal land will be agreed to jointly with the Bureau of Land Management, Soil Conservation Service, and the lessee prior to practice installation. The lessee will file with the Bureau of Land Management for formal approval to install planned conservation practices. Practices planned for federal land will not require financial participation of the Bureau of Land Management for installation.

Structural Measures

A floodwater retarding structure will be constructed in Spring Canyon near the south section line of sec. 27, T. 26 N., R. 63 W. The structure will control a drainage area of 7.24 square miles. The reservoir will have no permanent storage. No incidental recreation values will be present at the structural site, and public access will not be provided.

The dam will be a zoned earth embankment about 57 feet high containing a volume of about 296,000 cubic yards. The center zone will be constructed of fine silty sand or sandy silt and the outer shell of well-graded gravelly sand. About 120,000 cubic yards of unconsolidated silty sand will be excavated from the foundation and replaced with compacted earth before placing the embankment. The borrow area is upstream from the structural site in the proposed flood pool area. No clearing will be required for structural installation.

The reservoir will have a sediment capacity of 180 acre-feet, the expected

accumulation for the 75 years. Total capacity will be about 1,315 acre-feet at emergency spillway elevation.

The emergency spillway, constructed in the left abutment, will be about 60 feet wide. The inlet channel will be excavated in siltstone. Some fill will be placed in the exit channel. Due to the erosive nature of the emergency spillway, the emergency spillway hydrograph will be routed through the principal spillway with no flow through the emergency spillway.

The principal spillway will be a two-stage concrete drop inlet. The high stage will be set at the elevation of the 1 percent chance storm and the low stage at the elevation of the sediment pool. A maximum discharge of 20 cfs will be allowed to discharge from the low stage, and the high stage will discharge at a peak rate of 128 cfs. The two-stage riser will limit flow entering the Lucerne Canal to 20 cfs with larger discharges from events less frequent than a 1 percent chance of occurrence. The principal spillway discharges into the waterway of Spring Canyon. A drain pipe will remove water from the sediment pool.

Channel work will consist of:

1. Two grade stabilization structures installed in the 2,400-foot reach of the waterway of Spring Canyon directly downstream from the Interstate Canal. This reach, shown in table 3A as reach I, is the end of the defined waterway. Design capacity of each structure is 290 cubic feet per second.
2. A pipeline will be installed extending from the end of the waterway to the Lucerne Canal at a point below the crossing of U. S. Highway 26. The pipeline, shown in table 3A as reach II, will carry the controlled releases of the floodwater retarding structure from the damage area where no channel exists. Design capacity of the pipeline is 20 cfs.

A minimum of 100 acres of permanent easement will be required to construct, operate, and maintain the flood control facilities. Of this amount, 25 acres, including 5 acres for outlet channel works and 20 acres for the dam and spillways, will be required for structural works. The remaining 75 acres of permanent easement are for flood rights in the reservoir area. Installation of structural works will necessitate the use of alternative routes around the dam site for access to the upper part of the watershed. No persons or businesses will be displaced due to installation of structural works.

Additional information on structural measures is contained in tables 3, 3A, and 3B, and in figure 1.

EXPLANATION OF INSTALLATION COSTS

Estimated project installation cost is \$1,043,130. Land treatment practices are estimated to cost \$490,580 and the structural works \$552,550. (See table 1.) The estimated cost of land treatment measures includes \$421,080 for application of practices and \$79,500 for technical assistance.

The estimated installation cost of structural measures is \$552,550. The estimated cost of construction is \$452,500 including \$397,500 for construction of the dam and \$55,000 for construction of the diversion channel.

To account for undetermined problems or unusual work which may be required in construction, the construction cost estimate includes a 14 percent contingency. Engineering services required to insure proper installation of the structural measures are estimated to cost \$16,000. Engineering services include geologic and construction materials investigation, engineering design, construction surveys, and preparation of design plans and specifications. The cost of project administration is estimated to be \$74,300. Project administration costs include: construction inspection, \$20,000; supervisory and administrative services required for installation performed by other than engineers and geologists, \$49,300; and contract administration costs, \$5,000. Contract administration costs are professional and legal costs encountered during contract formulation, contract bid acceptance, and contract enforcement.

The estimated cost of land rights is \$9,750. Land rights include the value of easements (\$7,250) and costs of acquisition (\$2,500) to insure proper investigation, installation, and operation and maintenance of structural measures. The estimated value of easements required includes consideration for property value and an alternative access route necessitated by installation of structural works.

The estimated installation cost of land treatment measures includes \$35,000 of PL 566 funds for technical assistance to accelerate the rate of land treatment installation. The costs of technical assistance for the going program, \$44,500, and for application of the measures, \$411,080, will be from other funds.

The estimated installation cost of structural measures to be borne by PL 566 funds is \$537,800. The PL 566 cost includes \$452,500 for construction, \$16,000 for engineering services, and \$69,300 for project administration. The estimated cost of structural measure installation to be borne by other than PL 566 funds is \$14,750 including \$9,750 for land rights and \$5,000 for project administration.

A schedule for obligating funds to implement project measures is detailed in the table on page 22.

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention

Project structural measures will significantly reduce floodwater damages in the watershed. Residual or with-project damages are anticipated because of runoff from the uncontrolled drainage area below the detention dam. Protection will be afforded 1,140 acres, affecting 46 operating units, including 1,050 acres of cropland, eight farmsteads, U. S. Highway 26, and the Lucerne Canal.

Structural measures will reduce damages from a 5-year storm from \$70,000 to \$150 (99.7 percent). Cropland area flooded will be reduced from 300 to 10 acres. No damage will be incurred by farmsteads, U. S. Highway 26, or the Lucerne Canal.

Structural measures will reduce damages from a 100-year storm from \$200,000

OBLIGATION OF FUNDS
(Dollars)

Fiscal year :	1	2	3	4	5
Fund :	PL 566 : Other :	PL 566 : Other :	PL 566 : Other :	PL 566 : Other :	Other :
Land treatment :	3,500 : 45,500 :	5,250 : 68,300 :	8,750 : 113,900 :	8,750 : 113,980 :	8,750 : 113,900 :
Structural construction :	452,500 :	:	:	:	:
Engineering services :	16,000 :	:	:	:	:
Project administration :	69,300 : 5,000 :	:	:	:	:
Land rights :	9,750 :	:	:	:	:
TOTAL :	541,300 : 60,250 :	5,250 : 68,300 :	8,750 : 113,900 :	8,750 : 113,980 :	8,750 : 113,900 :

to \$65,000 (67.5 percent). Cropland area flooded will be reduced from 1,050 acres to 330 acres. Flood damage to farmsteads will be reduced from eight to three. Damage will occur to U. S. Highway 26, but detour and delay of traffic will be for a shorter period. Floodwater will enter and could breach the Lucerne Canal causing a delay in delivery of irrigation water to 4,000 irrigated acres.

Structural measures will provide sufficient protection to restore 85 acres of cropland to former productivity. The acres of cropland to be restored to former productivity accounts for 8 percent of the land in the floodplain, 27 percent of the benefits, and 40 percent of residual damages. Approximately \$9,000 of with-project damages in the 100-year storm are due to increased damages on the 85 acres of cropland to be restored to former productivity.

Average annual flood damages in the watershed will be reduced 95 percent or \$34,070. Secondary benefits, estimated to be \$4,150 annually, will accrue to the agribusiness industry serving the watershed area in the form of additional agricultural inputs provided and output handled.

Soil, Water, and Plant Communities

Soil, water, and vegetative management and conservation practices included in the plan will improve and enhance aesthetic, wildlife, and recreational values as well as increase agricultural production in the watershed. Conservation treatment of rangeland will improve ecological condition class and increase vegetative cover which will reduce average erosion on rangeland about 15 percent to 1.9 tons per acre per year. Average herbage production is expected to increase 45 percent to 890 pounds per acre annually.

Conservation treatment of cropland will maintain and enhance soil productivity and therefore provide for sustained intensive agricultural use and increased agricultural productivity. Conservation treatment will reduce average wind and water soil movement on cropland about 40 percent to 5 tons per acre annually. Planned treatment of cropland will increase irrigation water use efficiency. On-farm irrigation efficiency with planned treatment is expected to be about 50 percent or 25 percent greater than anticipated without planned treatment. Planned conservation treatments are necessary to maintain potential production projected for year 2000. (See discussion WATERSHED RESOURCES - ENVIRONMENTAL SETTING.)

Installation of structural measures will commit about 100 acres of rangeland to use as flood control facilities. Approximately 75 of the 100 acres consists of very sparse vegetation (see WATERSHED RESOURCES - ENVIRONMENTAL SETTING) in the waterway of Spring Canyon and will be committed to reservoir area and lost; the remaining 25 acres will continue to produce vegetation. Approximately 75 acres of rangeland will be disturbed during structural installation, and vegetation will be lost for about 2 years. All areas disturbed will be revegetated immediately after installation is completed.

Archeologic, Historic, and Scientific

No archeologic, historic, or scientific values will be affected by project

installation or operation. Installation and operation of the project will not affect any rare or endangered species of plants or wildlife.

Economic and Social

Project measures will exert an overall economic force which will tend to increase and stabilize income, reduce underemployment and unemployment, and reduce the rate of population outmigration. (See "Economic Data" previously presented in WATERSHED RESOURCES - ENVIRONMENTAL SETTING and "Economic and Social" previously presented in WATER AND RELATED LAND RESOURCE PROBLEMS.) Project installation will produce redevelopment and secondary economic benefits. An estimated 17 man-years of employment will be created for both skilled and unskilled labor during project-associated construction activities. The multiplier effect of expenditures for materials and wage earner spending will bolster the local economy. Average annual operation and maintenance will generate about one-tenth of a man-year of semi-skilled employment.

Increased production of agricultural commodities will create demand for additional agricultural inputs and services and generate more efficient operation of businesses serving agriculture in the local area. Increased agricultural production will also permit more efficient use of farm family labor as well as the local agricultural labor force.

The project will not displace any person, business, or farm operation.

Average annual project costs, benefits, and the ratio of benefits to costs, are summarized in table 6 attached.

PROJECT BENEFITS

Average annual benefits of project structural measures are estimated to be \$37,870. In addition, average annual flood damage benefits of \$350 are estimated to accrue because of land treatment measures. Average annual benefits of \$37,870 include \$33,720 of primary benefits from flood damage reduction and \$4,150 of secondary benefits. Secondary benefits are estimated to accrue as profit in the agribusiness industry serving the watershed area through increased demand for agricultural inputs and the processing, handling, and marketing of additional agricultural output. Secondary effects and benefits accruing from a national viewpoint were not considered pertinent to the economic evaluation. See tables 5 and 6.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of project structural measures evaluated 5 5/8 percent interest is \$31,450. (See table 4.) The average annual benefits of project structural measures are estimated to be \$37,870. The benefit cost ratio for structural measures is 1.2:1. Excluding local secondary benefits of \$4,150, the ratio of benefits to costs is 1.1:1. (See table 6.)

PROJECT INSTALLATION

The Lucerne Canal Company is a legal entity with authority to construct, operate, and maintain works of improvement. The Lucerne Canal Company has the power of eminent domain and agrees to use it if necessary to obtain land rights needed to install project measures. Funds needed to fulfill local obligations of the project will be provided by assessment through the Lucerne Canal Company.

Project measures will be installed in 5 calendar years. Structural works will be installed by the end of the first calendar year. Land treatment practices will be applied by the end of the fifth calendar year.

Land rights required for installation, operation, and maintenance of project structural measures will be secured by the Lucerne Canal Company prior to contracting for construction of structural measures. Securing land rights will include obtaining special use permits for federal lands involved, obtaining easements on privately-owned land, and required trespass and construction easements.

The Lucerne Canal Company will obtain an appraisal of privately-owned land from a qualified land appraiser to be used in negotiating easements to privately-owned lands required. In addition, the Lucerne Canal Company will secure necessary water rights, permits to construct, and other state license as required by state law.

The Lucerne Canal Company will install structural works under competitive contract. Project sponsors have formally requested the Soil Conservation Service to administer contracts for construction of the structural measures. An elected official of the Lucerne Canal Company will be responsible for working with the Soil Conservation Service during contracting and construction of structural measures.

The Soil Conservation Service will provide installation services including engineering surveys, construction plans and specifications, and construction inspection to insure proper installation of structural measures.

Installation of land treatment measures is the responsibility of landowners and operators in the watershed. The Lingle-Ft. Laramie Conservation District will provide technical assistance required to insure the installation of land treatment practices during the 5-year installation period.

The Soil Conservation Service will furnish technical assistance to the Lingle-Ft. Laramie Conservation District according to the program established by the district to install land treatment practices.

FINANCING PROJECT INSTALLATION

Project costs will be borne by local sponsors and by funds, as appropriated, under authority of Public Law 566. Public Law 566 financial assistance outlined in this work plan is not an obligation of funds. The availability

of funds for financial assistance under Public Law 566 is dependent on congressional appropriation.

The cost of installing planned land treatment practices will be borne by the landowner or operator. Financial assistance available through the Great Plains Conservation Program will be utilized to install practices. Technical assistance available through the Lingle-Ft. Laramie Conservation District will be utilized to plan and install the practices.

The cost of project structural measures not borne by Public Law 566 funds will be provided by the Lucerne Canal Company. To meet financial obligations, the Lucerne Canal Company will secure a loan of approximately \$15,000 under loan provisions of Public Law 566. Negotiations are underway, and a preliminary application for credit has been filed with the State Director of the Farmers Home Administration. Public Law 566 credit assistance will be used by project sponsors to defray costs of project administration incurred, to secure necessary easements and special use permits, and to purchase approximately 75 acres of privately-owned land as the site for the dam and reservoir.

The Public Law 566 share of project installation cost will be made available upon appropriation and when the following conditions have been met:

1. The work plan is approved.
2. The sponsors have met the requirements for needed land treatment by obtaining agreements to carry out recommended soil conservation measures and proper farm plans from owners of not less than 50 percent of the lands situated in the drainage area above the floodwater detention reservoir.
3. The sponsors have acquired all needed land rights, water rights, and construction permits.
4. The sponsors have adequate funds for construction.
5. The sponsors and the Service have executed project and operation and maintenance agreements.

PROVISIONS FOR OPERATION AND MAINTENANCE

Operation and maintenance of structural measures will be the responsibility of the Lucerne Canal Company. Maintenance will be performed on a force account basis; costs will be met by assessment of project beneficiaries through the Lucerne Canal Company. Average annual operation and maintenance costs are estimated to be \$500. Average annual operation and maintenance cost estimates are based on 1973 prices.

Operation and maintenance of structural measures may include:

1. Clearing of debris and soil from the diversion channel.
2. Clearing of principal spillway inlet.

3. Repair and maintenance of principal spillway.
4. Maintenance of vegetative cover on dam.
5. Repair and maintenance of emergency spillway.

Inspection of the structural works will be conducted annually. Joint inspection by the representatives of the Lucerne Canal Company and the Soil Conservation Service will be conducted annually for the first 3 years following installation. During the fourth and all successive years, an annual inspection will be conducted by the Lucerne Canal Company. The Lucerne Canal Company will conduct an inspection of structural works after every major storm during the life of the structure. A written report of all inspections will be submitted to the Soil Conservation Service. The report will outline maintenance requirements and works of corrective maintenance performed.

Maintenance inspection reports will be reviewed by the Soil Conservation Service. Evidence that inspections or required maintenance are not properly performed will be reported to the State Conservationist for corrective action.

A specific operation and maintenance agreement will be executed between the Lucerne Canal Company and the Soil Conservation Service before a project agreement for the construction of structural measures is completed.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Spring Canyon Watershed, Wyoming

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/		TOTAL
		Non-Federal Land	P. L. 566 Funds	Other Funds	
			Non-Federal Land SCS 3/	Non-Federal Land SCS 3/	
<u>LAND TREATMENT</u>					
Land Areas 2/					
Cropland	Acres	641		380,760	380,760
Pasture and Hayland	to be	427		21,300	21,300
Rangeland	treated	3,651		9,020	9,020
Technical Assistance			35,000	44,500	79,500
TOTAL LAND TREATMENT	XXXX	XXXX	35,000	455,580	490,580
<u>STRUCTURAL MEASURES</u>					
<u>Construction</u>					
Floodwater Retarding					
Reservoir	No.	1	397,500		397,500
Diversion Channel (N)(O) 4/	L.Ft.	4,550	55,000		55,000
Subtotal - Construction			452,500		452,500
<u>Engineering Services</u>			16,000		16,000
<u>Relocation Payments</u>					
<u>Project Administration</u>					
Construction Inspection			20,000		20,000
Other			49,300	5,000	54,300
Relocation Assistance					
Advisory Services					
Subtotal - Administration			69,300	5,000	74,300
<u>Other Costs</u>					
Land Rights				9,750	9,750
TOTAL STRUCTURAL MEASURES			537,800	14,750	552,550
TOTAL PROJECT			572,800	470,330	1,043,130

^{1/} Price base 1973

June 1973

^{2/} Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.^{3/} Federal agency responsible for assisting in installation of works of improvement.^{4/} Type of channel before project: (0) - none or practically no defined channel 2,150 linear feet.
(N) - unmodified, well defined natural channel 2,400 linear feet.

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of Work Plan Preparation)

Spring Canyon Watershed, Wyoming

Measures	Unit	Applied to Date <u>2/</u>	Total Cost (Dollars) <u>1/</u>
<u>LAND TREATMENT</u>			
Proper Grazing Use	Ac.	78	15
Planned Grazing Systems	Ac.	78	40
Pasture and Hayland Planting	Ac.	125	5,200
Irrigation Ditch Lining	L.Ft.	30,330	91,000
Irrigation Field Ditches	L.Ft.	29,330	5,870
Irrigation Pipeline	L.Ft.	3,480	7,830
Irrigation Water Management	Ac.	535	2,675
Irrigation Land Leveling	Ac.	245	36,750
Irrigation Water Pumping Plant	No.	3	10,500
Irrigation Water Control Structures	No.	43	12,900
Irrigation Wells	No.	5	30,000
Fire Control	Ac.	18,865	2,200
TOTAL			204,980

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1/ Price base 1973

2/ Preceding 5-Year Summary

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Spring Canyon Watershed, Wyoming

(Dollars) 1/

Item	Installation Cost P. L. 566 Funds			Installation Cost - Other Funds		Total Installation Cost
	Construction	Engineering	Total P. L. 566	Land Rights	Total Other	
Floodwater Retarding Structure Diversion Channel (N)(0) <u>2/</u>	397,500 55,000	14,000 2,000	411,500 57,000	9,000 750	9,000 750	420,500 57,750
Project Administration			69,300		5,000	74,300
GRAND TOTAL	452,500	16,000	537,800	9,750	14,750	552,550

1/ Price base 1973

2/ Type of channel before project: (0) - none or practically no defined channel 2,150 linear feet.

(N) - unmodified, well defined natural channel 2,400 linear feet.

3/ Includes \$7,250 for value of easements and \$2,500 for costs of acquisition.

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TABLE 3 - STRUCTURAL DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY

Spring Canyon Watershed, Wyoming

ITEM	UNIT	Floodwater Re- tarding Structure
Class of Structure		b
Drainage Area	Sq. Mi.	7.24
Curve No. (1-day) (AMC II)		70
Tc	Hrs.	1.4
Elevation Top of Dam	Ft.	4361
Elevation Crest Emergency Spillway	Ft.	4352.5
Elevation Crest High Stage Inlet	Ft.	4346
Elevation Crest Low Stage Inlet	Ft.	4328
Maximum Height of Dam	Ft.	57
Volume of Fill ^{1/}	Cu. Yds.	416000
Total Capacity ^{2/}	Ac. Ft.	1315
Sediment Aerated	Ac. Ft.	180
Retarding	Ac. Ft.	1135
Between high and low stage	Ac. Ft.	695
Surface Area		
Sediment Pool ^{3/}	Acres	(22)
Retarding Pool ^{2/}	Acres	75
Principal Spillway Design		
Rainfall Volume (Areal) (1 day)	In.	3.6
Rainfall Volume (Areal) (10 day)	In.	6.0
Runoff Volume (10 day)	In.	2.5
Capacity of Low Stage (Max.)	cfs	20
Capacity of High Stage (Max.)	cfs	128
Frequency Operation - Emer. Spillway	% chance	*
Diameter of Conduit		30
Emergency Spillway Design		
Rainfall Volume (ESH) (Areal)	In.	5.2
Runoff Volume (ESH)	In.	2.2
Storm Duration	Hrs.	6
Type		Earth
Bottom Width	Ft.	60
Velocity of Flow (Ve)	Ft./Sec.	0**
Slope of Exit Channel	Ft./Ft.	.02
Maximum Water Surface Elevation	Ft.	4352.5**
Freeboard Design		
Rainfall Volume (FH) (Areal)	In.	10.0
Runoff Volume (FH)	In.	6.2
Storm Duration	Hrs.	6
Maximum Water Surface Elevation	Ft.	4361
Capacity Equivalents		
Sediment Volume	In.	0.47
Retarding Volume	In.	2.94

^{1/} Total Earthwork (Includes 120,000 Cu. Yds. Excavation and Backfill of Foundation).

^{2/} At crest of Emergency Spillway

^{3/} Sediment Pool will be drained

* Less than 1%.

** ESH is controlled through principal spillway.

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TABLE 3A - STRUCTURAL DATA

CHANNELS

Spring Canyon Watershed, Wyoming

Reach	Length (Feet)	Total <u>1/</u> Drainage Area (Sq.Mi.)	Design Capacity (cfs)	Slope (Ft./Ft.)	Channel Dimensions		Velocity (Ft./Sec.)	Type <u>2/</u> of Work	Type of <u>3/</u> Channel	Flow <u>4/</u> Conditions
					Area (Sq.Ft.)	Wetted Perimeter (Ft.)				
I	2,400	7.91	290	.001	140	100	2	V	N	E
II	2,150	7.91	20	.012	24" Diam. Pipe		6	IL	O	E

1/ 7.24 square miles is controlled by the floodwater retarding structure.2/ I - Establishment of new channel

V - Stabilization of channel (construction of two grade stabilization structures)

L - Impervious lining

3/ N - Unmodified, well defined natural channel

O - No channel

4/ E - Ephemeral - flows only during periods of surface runoff.

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TABLE 3B - STRUCTURAL DATA

GRADE STABILIZATION STRUCTURES

Spring Canyon Watershed, Wyoming

Location	Number of Structures	Total ^{1/} Drainage Area	Design ^{2/} Capacity	Assoc. Frequency of Storm	Drop Each Structure	Concrete Each Structure	Type of Structure
(Reach)	(No.)	(Sq.Mi.)	(cfs)	(% chance)	(Ft.)	(C.Y.)	
I	2	7.91	290	10	4	35	<u>3/</u>

1/ 7.24 sq. mi. are controlled by the floodwater retarding structure.

2/ Includes 20 cfs controlled floodwater release.

3/ Straight drop spillway.

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TABLE 4 - ANNUAL COST

Spring Canyon Watershed, Wyoming

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost <u>2/</u>	Operation and Maintenance Cost	Total
Floodwater Retarding Structure and Outlet Canal	27,350	500	27,850
Project Administration	4,250		4,250
GRAND TOTAL	31,600	500	32,100

1/ Price base 1973

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2/ 75 years @ 5 5/8 percent interest.

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Spring Canyon Watershed, Wyoming
(Dollars) ^{1/}

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	24,770	1,030	23,740
Other Agricultural	8,100	970	7,130
Nonagricultural	100	5	95
Subtotal	32,970	2,005	30,965
Sediment			
Overbank deposition	910	65	845
Indirect	2,465	205	2,260
Total	36,345	2,275	34,070

^{1/} Price base: Adjusted Normalized

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Spring Canyon Watershed, Wyoming

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS <u>1/</u>		Total	Avg. Annual Cost <u>3/</u>	Benefit Cost Ratio
	Damage Reduction <u>2/</u>	Secondary			
Floodwater Retarding Structure and Outlet Canal	33,720	4,150	37,870	27,850	1.4:1.0
Project Administration				4,250	
GRAND TOTAL	33,720	4,150	37,870	32,100	1.2:1.0

1/ Price base

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$350 annually.

3/ From table 4.

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INVESTIGATION AND ANALYSES

Geologic

A preliminary geologic investigation was made of the watershed to determine the most suitable dam sites. Three possible storage sites were selected. Only two sites appeared to be geologically feasible for earth dam construction. The upper site appeared to be the least complex; however, because of hydrologic considerations, it was necessary to select the lower, more complex site.

A detailed investigation was made of this site during the spring of 1971. Foundation, abutment, spillway, and borrow conditions were explored with the use of a power auger, backhoe, and large rotary drill rig. The test pits and holes were located and logged, and undisturbed cores and large disturbed samples were collected for laboratory analysis and design purposes. In-place density tests were performed in the foundation materials, and borrow and spillway volumes were computed.

No historical or archeologically significant features were encountered during detailed site investigations in Spring Canyon Watershed.

Hydrologic

There are not sufficient permanently installed stream gages in the hydrologic region to provide reliable estimate of streamflow frequencies for either flood rates or volumes. Flood flows and runoff volumes have been estimated using synthetic hydrographs utilizing the procedure described in section 4 of the National Engineering Handbook. Resulting hydrographs have been subjectively compared to historical information obtained by the staff economists. Miscellaneous discharge measurements of floods in the region and data obtained from the USGS flood hydrograph studies in Wyoming have been used to further substantiate reasonableness of the estimates obtained from standard procedures.

The estimates of areas flooded during two floods--1955 and 1969--were obtained from interviews of local residents. The area flooded by the 1955 flood was taken as very near the area which might be flooded by a 100-year flood. The 1969 flood has been assigned a 5-year recurrence frequency. A lower level of flooding was estimated based on a survey of a ponding area and volume in the field most frequently flooded on the fan at the mouth of Spring Canyon. This was assigned a 2-year frequency of occurrence. Flooded areas for other frequencies were obtained by plotting these flooded areas against the streamflow volumes estimated for these frequencies and then using the resulting graph and other streamflow estimates to obtain the flooded areas for other frequencies.

Structural design hydrographs were obtained using the procedures given in chapter 21 of section 4 of the National Engineering Handbook with rainfall amounts taken from the maps given in that reference. These hydrographs

are routed through the structural sites using the procedures of SCS Technical Release 33 and 35.

Melt rates are low enough and infiltration rates high enough that there is seldom any snowmelt-produced runoff. Some runoff is produced from general frontal storms, but these seldom result in flood damages. Short but intense summer thunderstorms produce very high peak rates of flow of fairly short duration which cause considerable floodwater, debris, and sediment damage.

Economic

Investigations were conducted to determine the type and extent of watershed problems. Interviews with watershed sponsors and long-time residents in the community were the basis for formulating detailed investigations. The principal water-related problem in the watershed is floodwater runoff. Types of flood damage incurred include: Crop, irrigation canal damage and associated delay in delivery of irrigation water, road and highway, farmstead, and other agricultural damage.

Extent of damage by type was collected by interview with floodplain residents and farm operators, irrigation canal company officials, state highway officials, county commissioners, and from accounts of flood events recorded in local newspapers. The extent of damage incurred in the 1955 and 1969 flood events was estimated. Damage estimates for historic events were adjusted to reflect future damages in the floodplain during the project evaluation period. Land use, crop yields, and production expenses were projected to the year 2000 and used as representative values during the evaluation period. Projections were based on the Missouri River Basin Comprehensive Framework Study projections for the resource area including Spring Canyon Watershed. Percent damage factors determined by budgeting flood damages from the 1955 and 1969 flood events were applied to projected values in the year 2000 to estimate future without project damages. Damage estimates were correlated with hydrologic runoff estimates and percent chance of occurrence estimates to formulate a damage frequency curve and estimate average annual damage. Adjusted normalized commodity prices and crop production expenses were used in budgeting and evaluating agricultural production flood damages.

Interview data obtained from present and past officials of the Lucerne Canal Company were used to estimate future canal damages. Future without project damages to the Lucerne Canal were estimated for increased canal maintenance cost, the cost of repairing breaks in the canal, and damages incurred by irrigated crops due to the delay in delivery of irrigation water during repair of canal breaks. Damage to irrigated crops from interrupted irrigation was estimated by correlating production value with net irrigation requirements. Value added per inch of net irrigation requirement was adjusted to value added per day by month during the irrigating season. Losses incurred because of interrupted irrigation were estimated for the period of delay and adjusted for the seasonality of delay using the monthly distribution of damaging storm events. Damage

estimates from delayed irrigation were developed based on projected land use and crop yields for year 2000 to represent the evaluation period. Adjusted normalized commodity prices and production expenses were used. Damage estimates for the canal and delayed irrigation were correlated to percent chance of occurrence and a damage frequency curve developed to estimate average annual damage.

Road and highway damages were obtained by budgeting information on the type and extent of damage incurred during the 1955 and 1969 flood events. Data were obtained by interview with county commissioners, state highway officials, and from newspaper accounts. Damage estimates were made for debris removal, cleanup, and road repairs. Losses incurred because of traffic detour and delay were made from increased mileage and additional time required because of detour. Projected traffic count for the year 2000 was used in estimating losses because of detour.

Farmstead and other agricultural damage estimates were made based on interview data obtained from floodplain residents.

Damage estimates for with-project conditions were made following the procedures outlined above by correlating without and with-project runoff estimates to obtain damage estimates by frequency. Average annual with project damages were estimated based on the damage frequency curve developed.

Project benefits from restoration to former productivity were estimated. Benefits from restoring 85 acres of previously cropped land to former productivity were evaluated by determining the change in net return from present productivity to productivity projected for year 2000 after deducting costs for redeveloping the land. Adjusted normalized commodity prices and production costs were used in evaluation.

Criteria and procedures outlined in the Economics Guide for Watershed Protection and Flood Prevention were followed throughout the economic evaluation.

Engineering

The Wyoming State Conservation Commission supplied surveys of the selected reservoir location through contracts with land surveyors.

Foundation conditions at the dam location are severe. Excessive settlement can be expected to occur in the loose, fine, silty sand or sandy silt (SM or ML) 20 to 40 feet deep on the right side of the principal channel. A well-graded gravelly sand (SW) ^{12/} is 15 to 25 feet deep on the left side. The underlying siltstone bedrock forms the left abutment and is exposed at the elevation of the top of the dam in the right abutment. The light weight SM material is unconsolidated, and laboratory tests indicate a consolidation of 14 percent of the compressible layer can be expected when saturated and loaded.

^{12/} As designated by Unified Soil Classification System and defined by ASTM D2487.

Consolidation of the SM foundation material in place by wetting before loading with embankment was considered. Prewetting of the foundation is not planned because of the uncertainty of maintaining a saturated condition while loading. The excavation of a wide cutoff trench in the SM material to the depth of siltstone is planned as a more positive method of controlling excessive foundation settlement.

The available SM material will be used as embankment to provide a relatively impervious core. The fines, when compacted, will be brittle and susceptible to cracking. An outer shell of SW material is planned to protect against the formation of transverse cracks through the entire embankment section. A massive downstream zone of SW is planned to provide drainage and filtering action to protect the SM section against piping or washing through cracks.

The dam and spillways are proportioned to meet the criteria set forth in Soil Conservation Service Engineering Memorandum 27.

The principal spillway release rate of 20 cubic feet per second was determined by the Lucerne Canal Company as the rate of flow that can safely be added to the Lucerne Canal at this location.

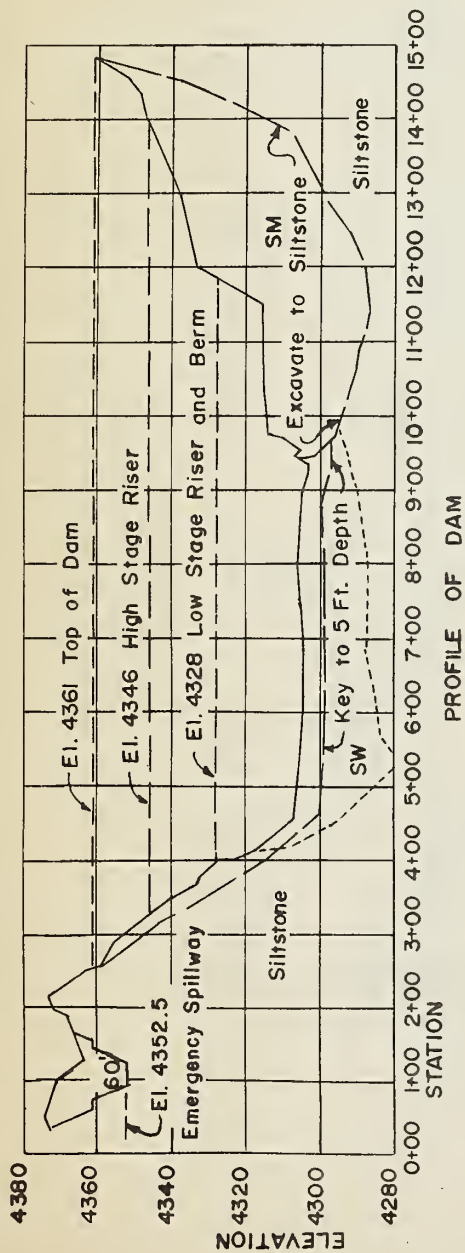
The siltstone which will form the control section of the emergency spillway is firm and stable at the time of excavation. After exposure the siltstone will weather rapidly and become an erosive material. The exit channel of the spillway will be SM and SW material. A dense vegetative cover will not be maintained on the spillway. Because of the erosive soils and the sparse vegetation, the emergency spillway should be treated as an earth spillway with low permissible velocity. It is planned to be protected from use during the passing of the emergency spillway hydrograph. The high stage of the principal spillway was planned to utilize the capacity of the principal spillway barrel and limit the required height of the earth emergency spillway.

Channel stabilization will be required in the reach of natural channel of Spring Canyon directly below the Interstate Canal. Grade control structures will provide for safe velocity of flows. Design capacity will be equal to peak flows expected in storms of 10 percent chance of occurrence.

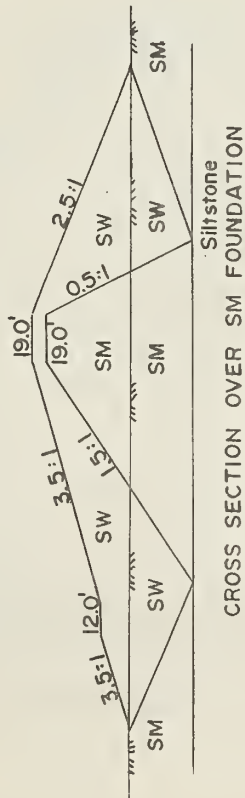
Because the channel of Spring Canyon ends within the damage area, structural works are required to provide for flows from the principal spillway of the floodwater retarding structure. The underground conduit discharging into the Lucerne Canal was selected as the most desirable method to convey low flows of long duration from the damage area. The route and structural works were selected after considering costs, maintenance requirements, and the effects of channels and conduits in the area. The capacity of the conduit will be equal to the controlled release of 1 percent chance event from the floodwater retarding structure.

Other proposals that were considered in proportioning the floodwater retarding structure include the use of two-stage inlet principal spillways of large capacity at high stage; a concrete chute spillway for emergency flows; and a lined emergency spillway. None of the alternative structural plans result in more economical structural works.

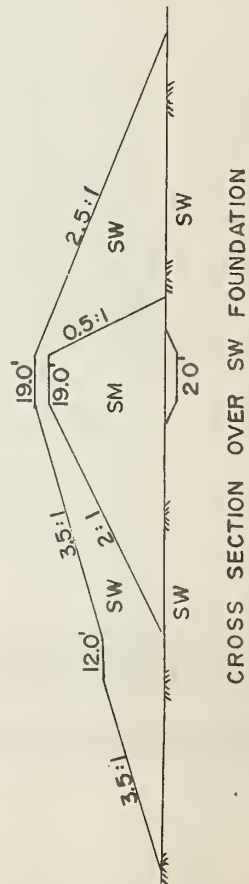
The use of earth and lined channels, as well as underground conduit, were considered for carrying the principal spillway releases to the Interstate Canal, to the Lucerne Canal, and to the North Platte River. Releases into the Interstate Canal can be made only after protection from other runoff areas is provided to the canal. Delivery to the North Platte River involves the cost of crossing a U. S. highway, a railroad, and additional irrigated lands.



PROFILE OF DAM



CROSS SECTION OVER SM FOUNDATION



CROSS SECTION OVER SW FOUNDATION

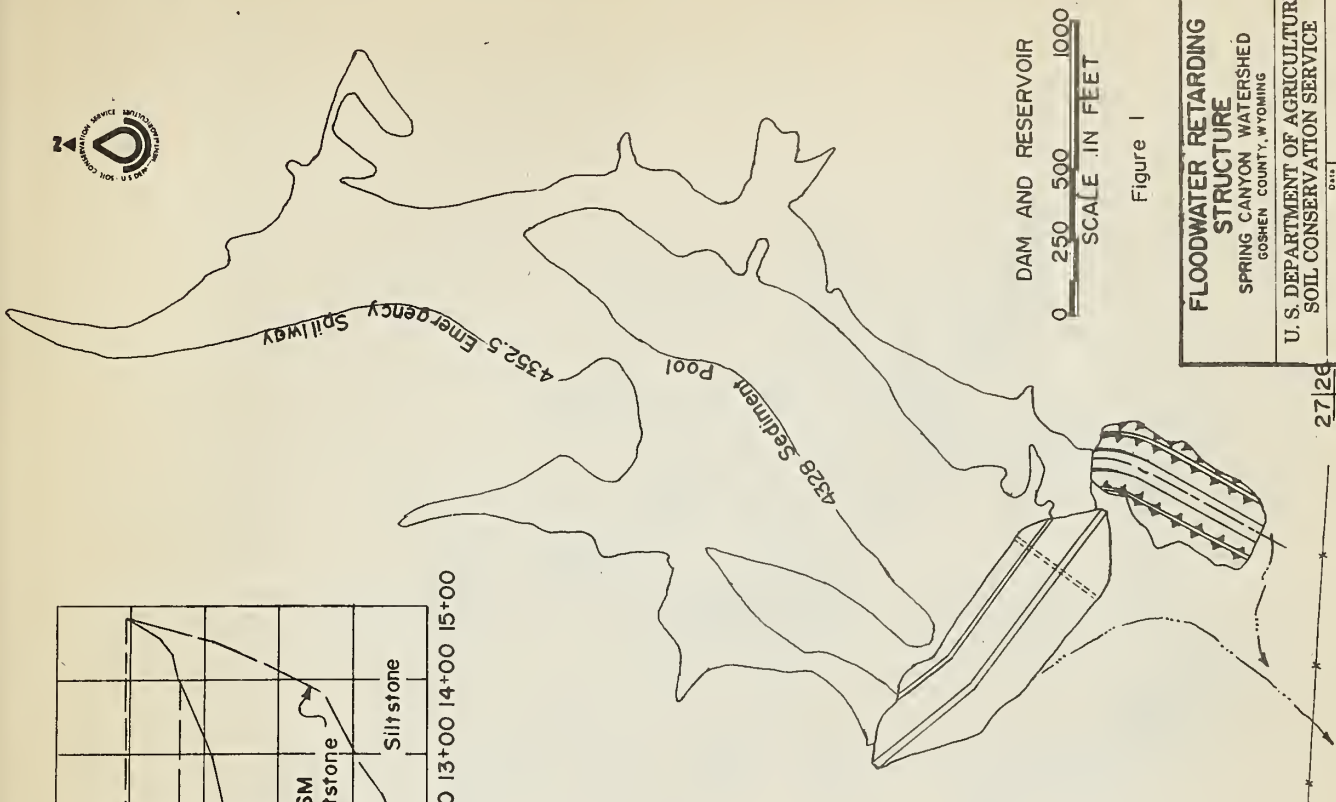


Figure 1

DAM AND RESERVOIR

0 250 500 1000

SCALE IN FEET

FLOODWATER RETARDING STRUCTURE

SPRING CANYON WATERSHED
GOSHEN COUNTY, WYOMING

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

$$\begin{array}{r} 27 \overline{) 26} \\ 34 \overline{) 35} \end{array}$$
$$\begin{array}{r} 2120 \\ 34 \overline{) 7208} \\ \underline{68} \\ 40 \\ 34 \\ \underline{6} \\ 60 \\ 58 \\ \underline{20} \\ 20 \\ \underline{0} \end{array}$$

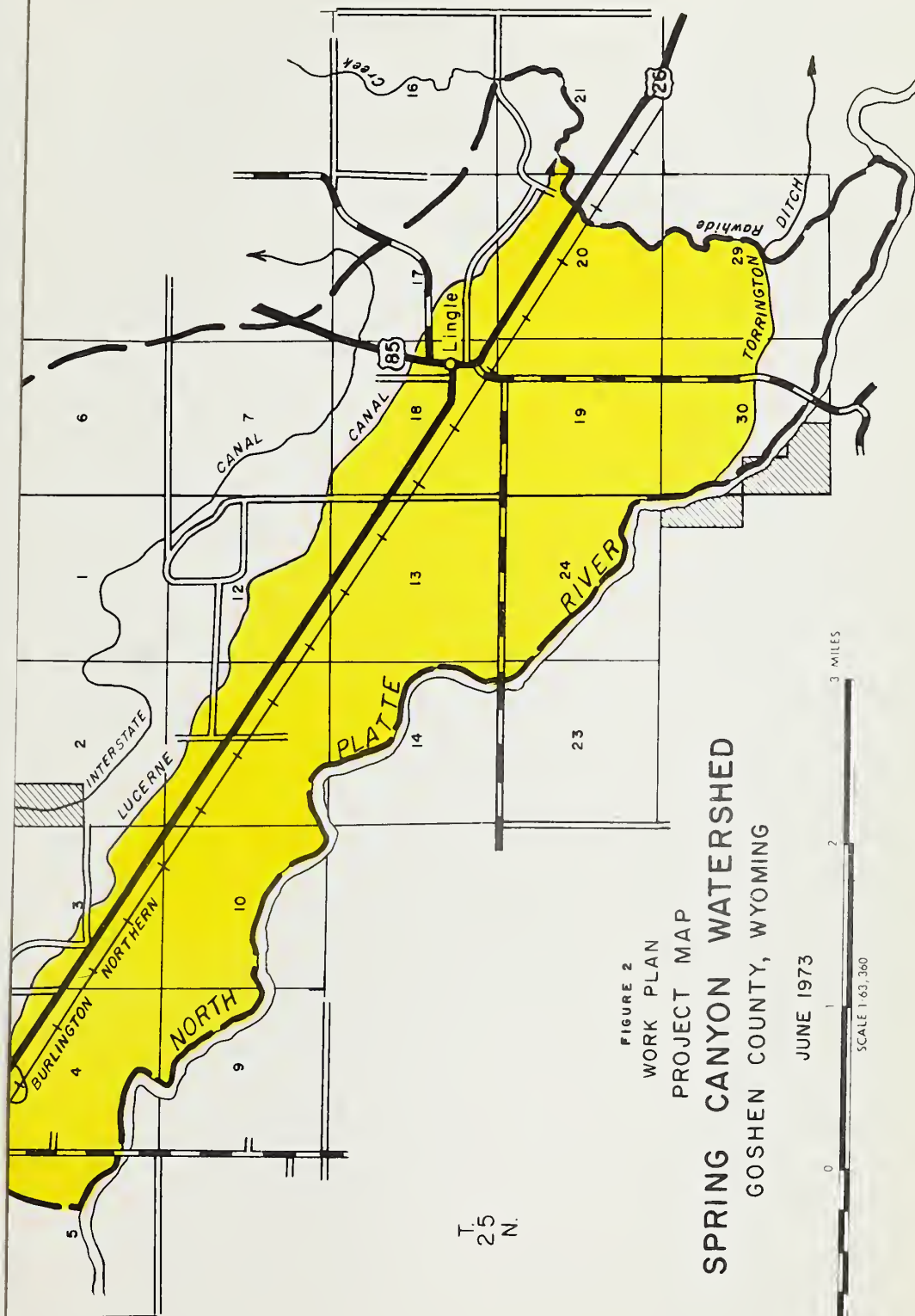


FIGURE 2
WORK PLAN
PROJECT MAP
SPRING CANYON WATERSHED
GOSHEN COUNTY, WYOMING
JUNE 1973

SCALE 1:63,360



LOCATION MAP

R 63 W.



T. 26 N.

T. 25 N.

LEGEND

- Township Line
- Section Line
- 26 Section Number
- Paved Road
- Dirt Road
- Railroad
- Perennial Stream, Large
- Perennial Stream, Small
- Intermittent Stream
- Irrigation Canal
- Watershed Boundary
- Drainage Area Controlled By Structure
- Area Benefited
- Floodwater Retarding Structure
- Grade Control Structure
- Closed Conduit
- 4634 Drainage Area - Acres
- Federal Land

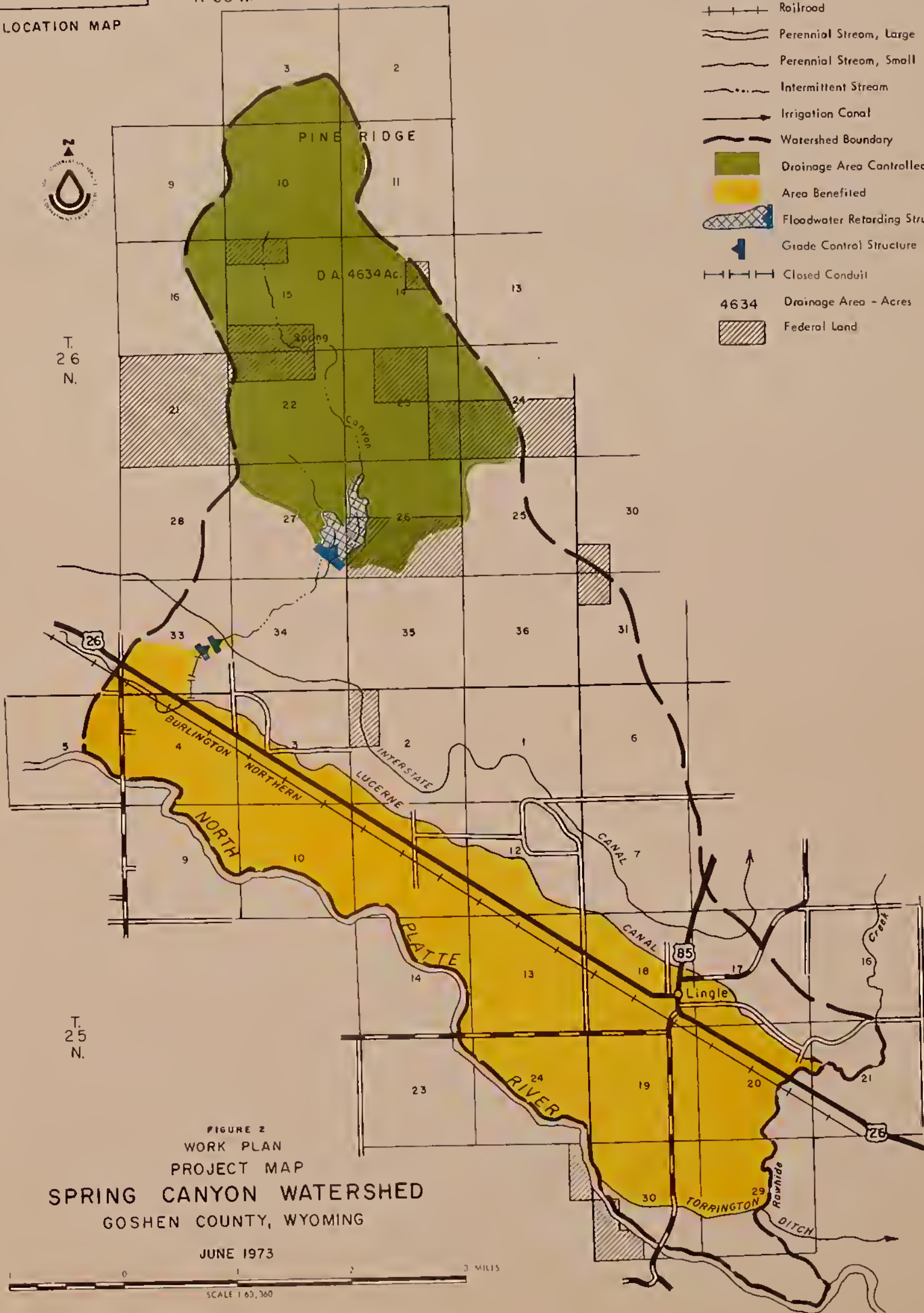


FIGURE 2
WORK PLAN
PROJECT MAP
SPRING CANYON WATERSHED
GOSHEN COUNTY, WYOMING

JUNE 1973

SCALE 1 63,360

